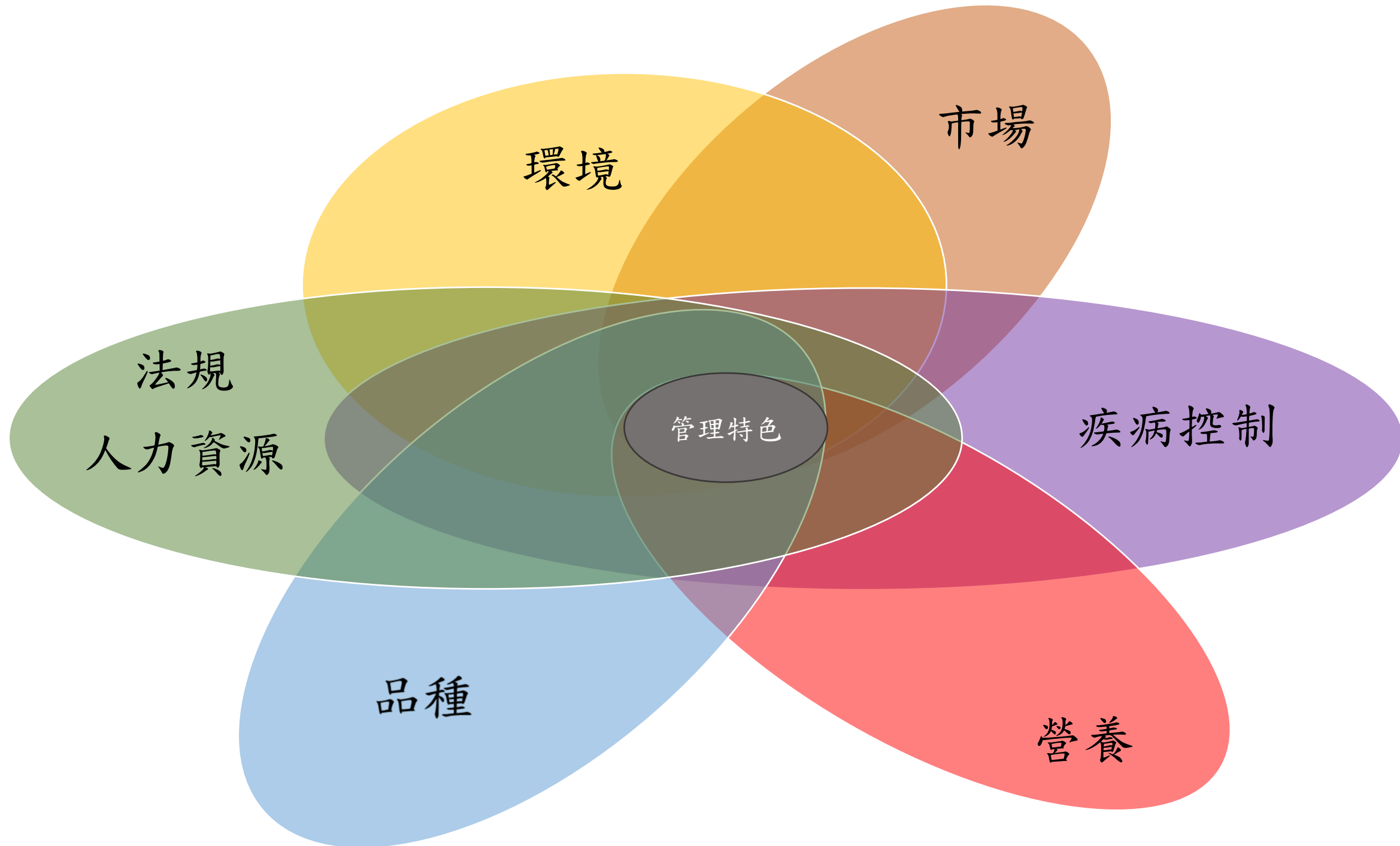


丹麥養豬管理的特色

李嘉偉

國立屏東科技大學

熱帶農業暨國際合作系



現實狀況



丹麥

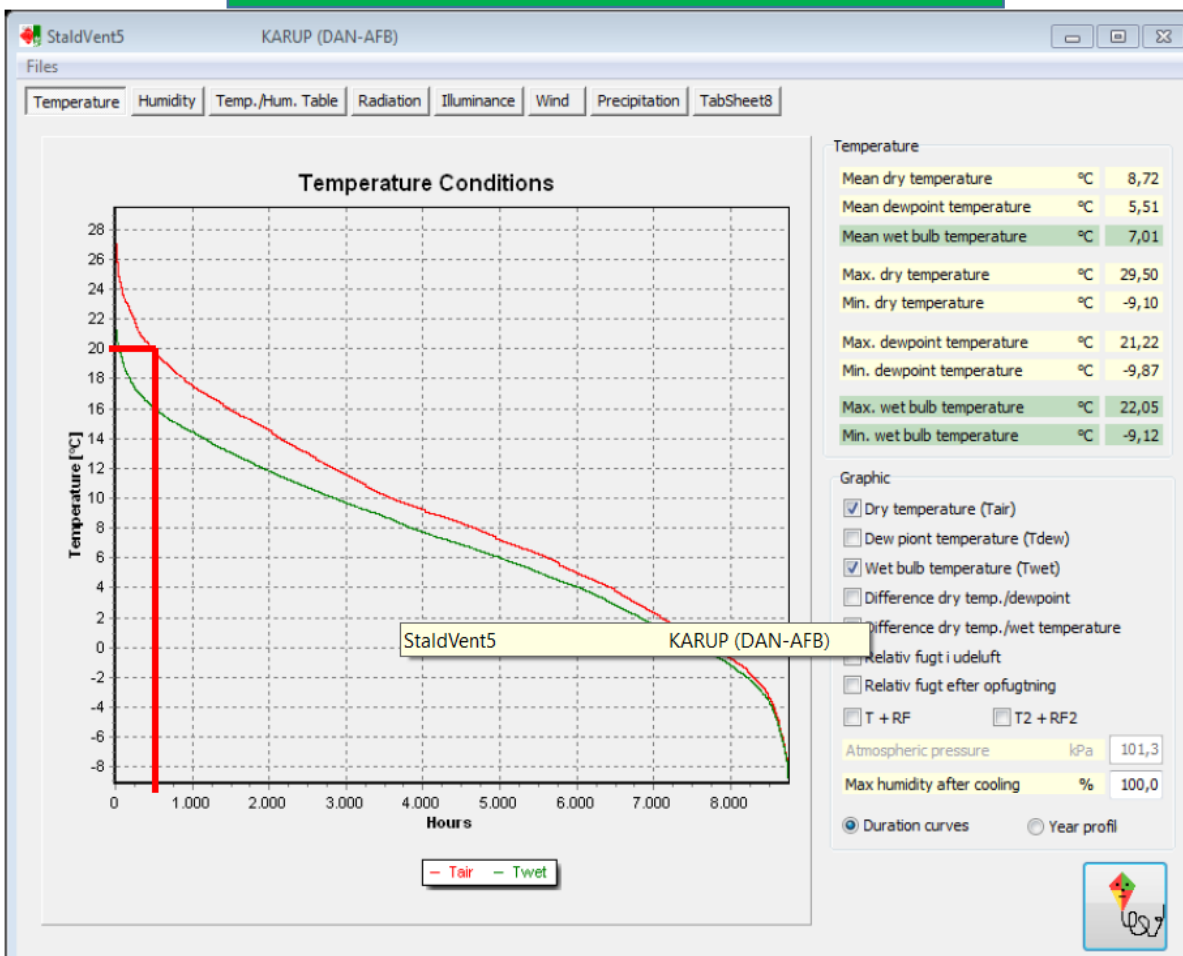


台灣

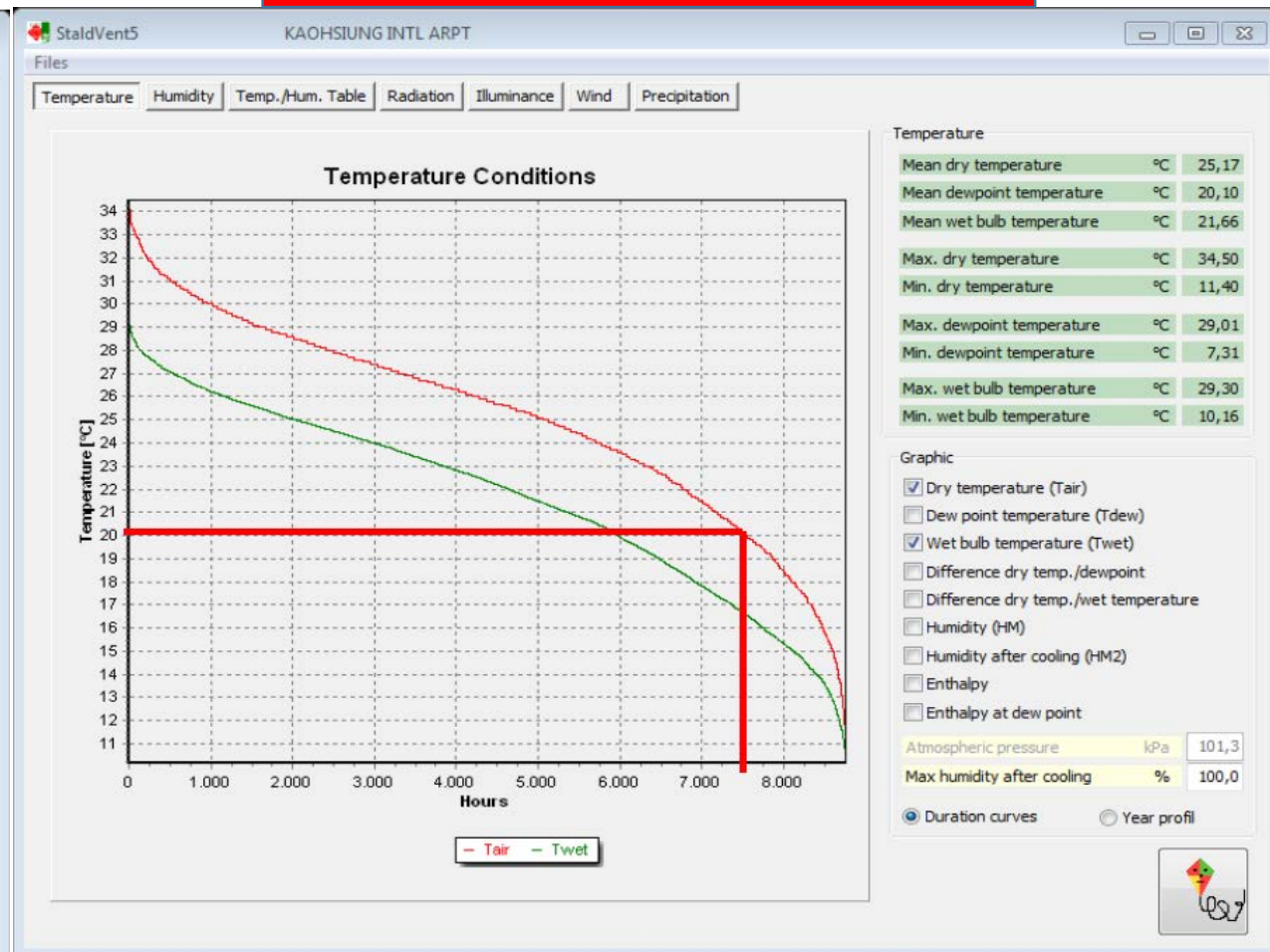


氣候的條件

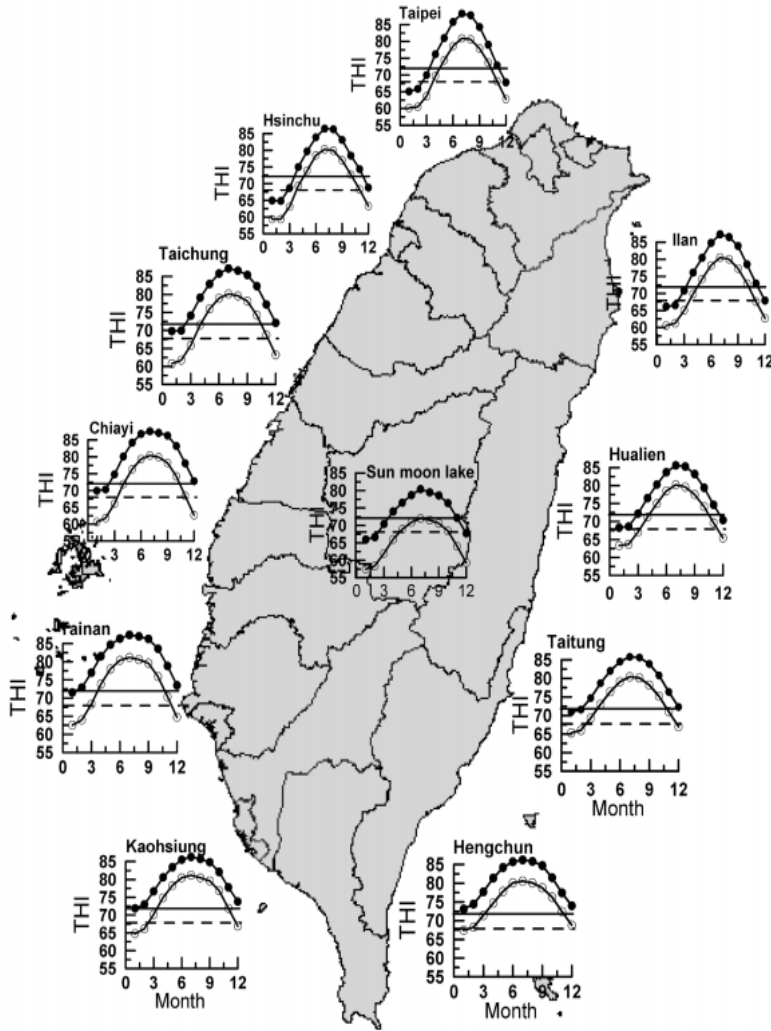
丹麥



台灣



熱緊迫



Monthly THI from 1976 to 2005 in Taiwan area (● for maximum THI, ○ for average THI, dotted line for THI=68; solid line for THI=72).

- THI > 72 (8.55 月) 有熱緊迫
- THI 72~79 (2.55 months) 中度熱緊迫
- THI 79~89 (6 months) 嚴重熱緊迫

Temperature Humidity Index (THI)									
Relative Humidity %									
C	20	30	40	50	60	70	80	90	100
22	66	66	67	68	69	69	70	71	72
24	68	69	70	70	71	72	73	74	75
26	70	71	72	73	74	75	77	78	79
28	72	73	74	76	77	78	80	81	82
30	74	75	77	78	80	81	83	84	86
32	76	77	79	81	83	84	86	88	90
34	78	80	82	84	85	87	89	91	93
36	80	82	84	86	88	90	93	95	97
38	82	84	86	89	91	93	96	98	100
40	84	86	89	91	94	96	99	101	104

No heat stress

Moderate heat stress

Severe heat stress

熱緊迫條件下母豬的生產性能

Farrowing sows in hot climate

	20 °C	29 °C
Feed intake sow, kg/day	7.63	4.22
Daily gain litter, kg/day	2.914	2.152
Weight loss during lactation, kg	16	34
Water to feed ratio, l/kg	4.0	7.5
Respiration, breaths per minute	33	105
Rectal temperature, °C	38.8	39.5
Skin temperature, °C	36.1	37.8
Milk production, kg/day	10.43	7.35
Dry matter in milk (day 14), %	18.6	18.1
Energy in milk (day 14), MJ/kg	4.96	4.75
Weight piglets day at 28, kg	9.51	7.52
Daily gain piglets, g/day	272	203
Creep feeding, g/litter/day	232	388

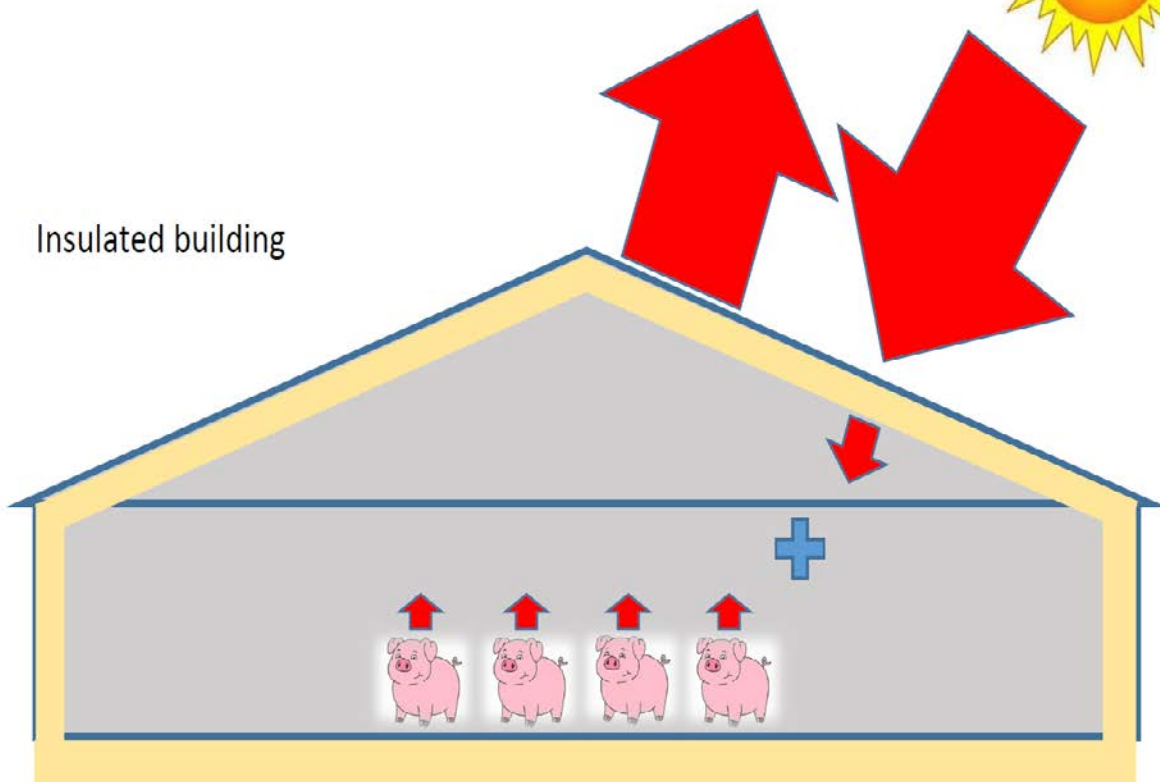
畜舍的隔熱

丹麥

Climate and housing

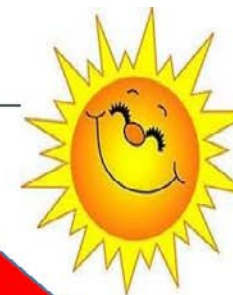


Insulated building

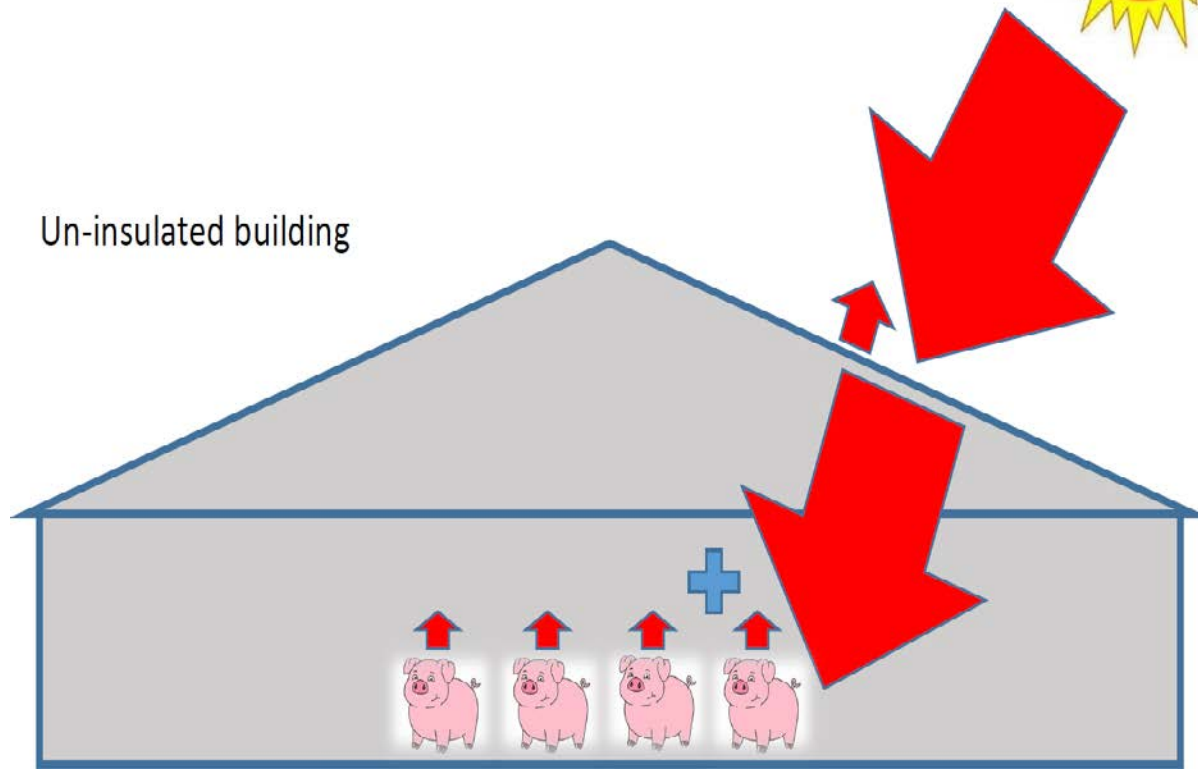


台灣

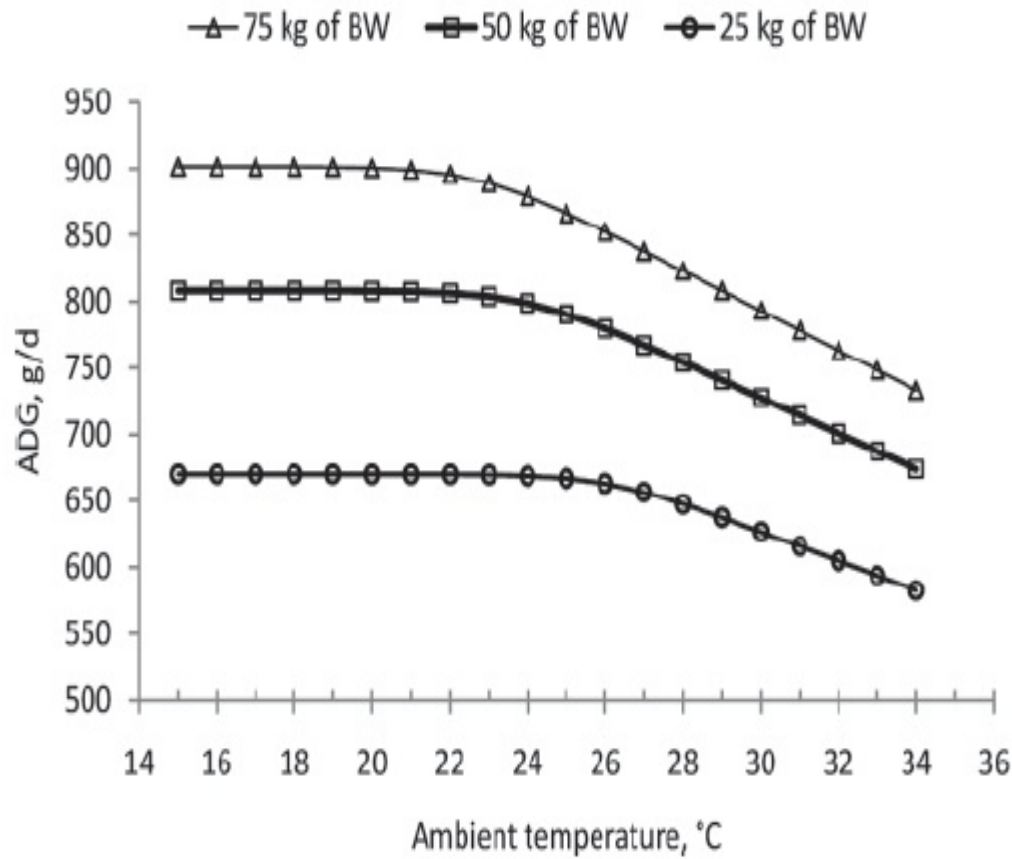
Climate and housing



Un-insulated building



Heat stress - reduced performance



A GUIDE (ONLY) TO AIR TEMPERATURE ACCORDING TO FLOOR TYPE									
		Floor Type							
Weight Pig kg	(lbs)	Straw		Concrete		Perforated Metal		Slatted	
		°C	(°F)	°C	(°F)	°C	(°F)	°C	(°F)
5	(11)	27-30	(81-86)	28-31	(82-88)	29-32	(84-90)	30-32	(86-90)
10	(22)	20-24	(68-75)	22-26	(72-79)	24-28	(75-82)	25-28	(77-82)
20	(44)	15-23	(59-73)	16-24	(61-75)	19-26	(66-79)	19-25	(66-77)
30	(66)	13-23	(55-73)	14-24	(57-75)	18-25	(64-77)	17-25	(63-77)
90	(198)	11-22	(52-72)	12-23	(54-73)	17-25	(63-77)	15-24	(59-75)

(Renaudeau et al., 2019)

提供豬隻最適合的 環境與設備

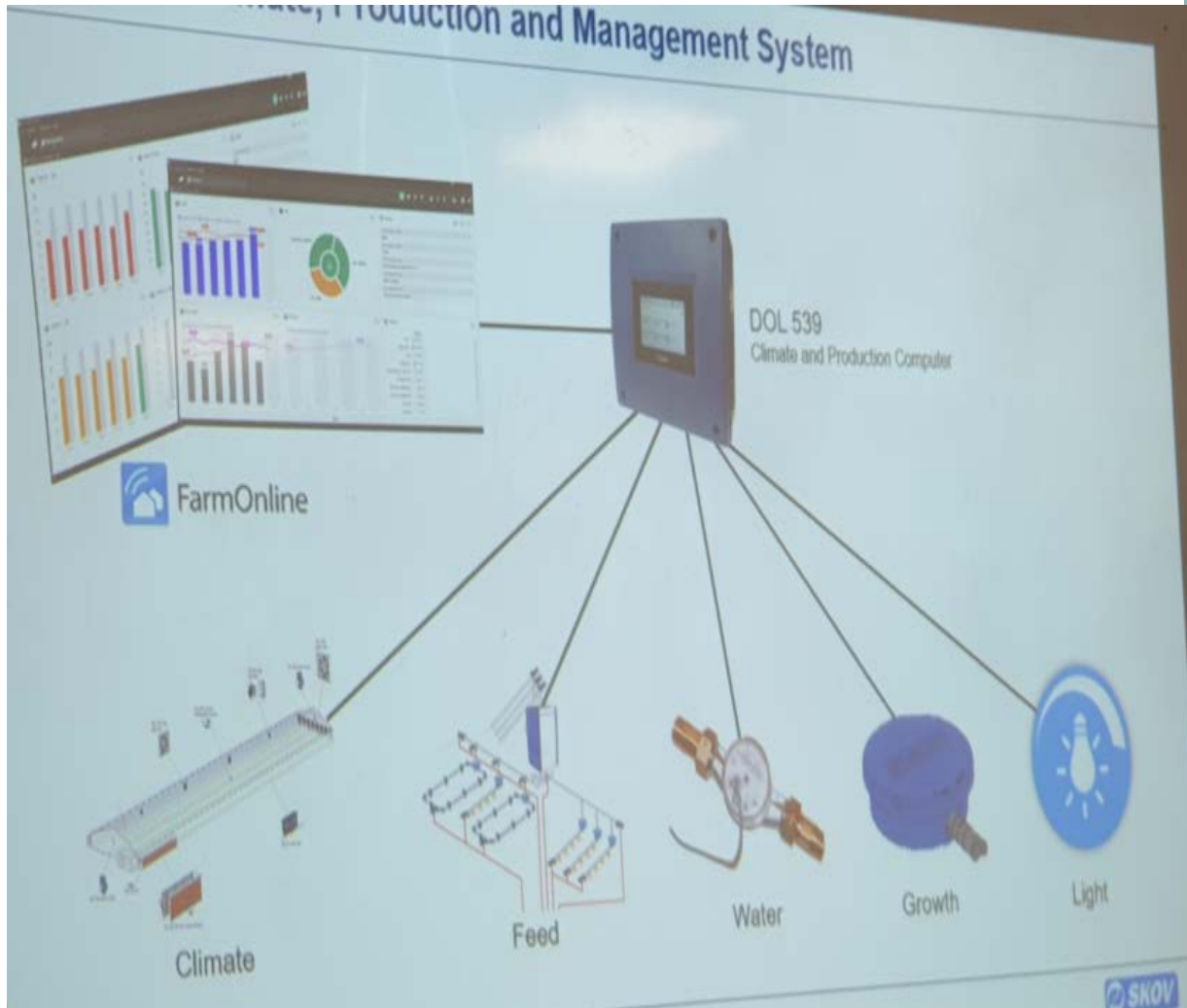
硬體設備與環境監控



硬體設備與環境監控



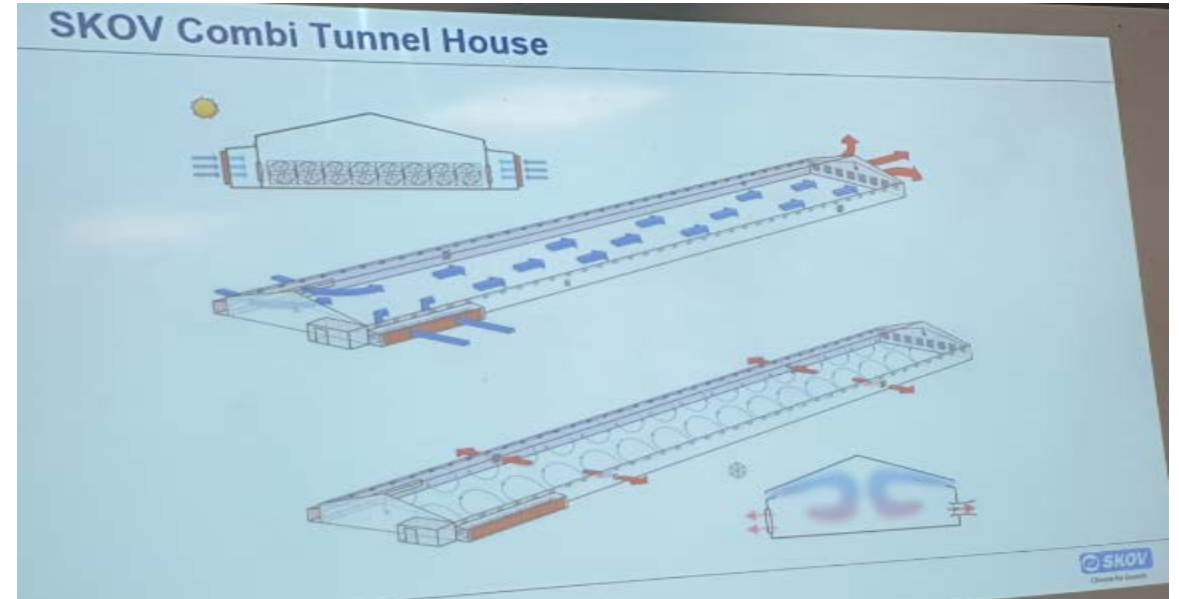
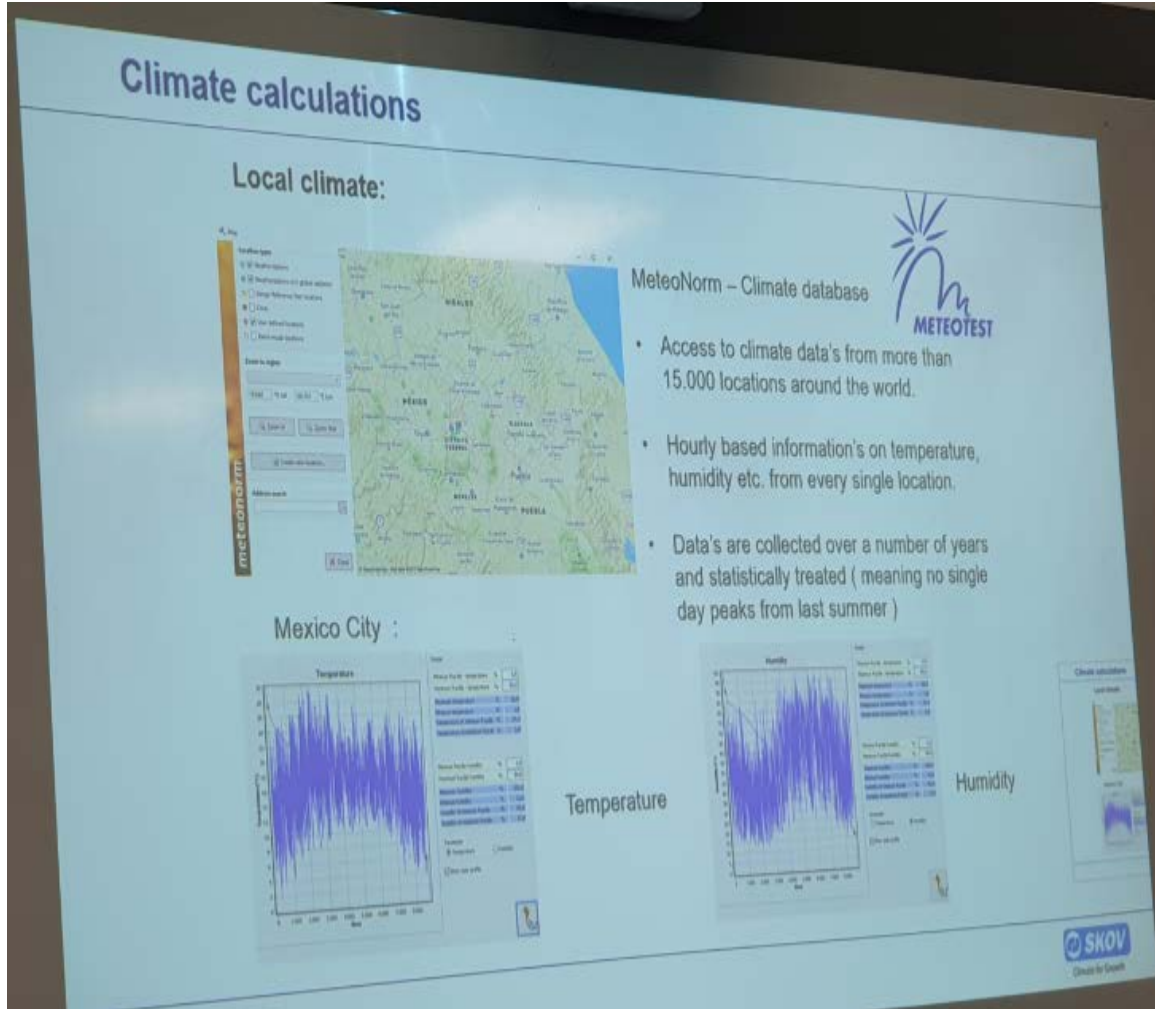
硬體設備與環境監控



What does SKOV deliver to customers?

SKOV
Climate for Growth

硬體設備與環境監控



硬體設備與環境監控

programming of sensors, test and

Production of capacitive sensors and climate sensors such as temperature, humidity, CO₂ and ammonia sensors.

Hot-melt moulding of many sensors at 220°C and a pressure of 10-40 Bar.

Automatic functional test and programming of all our sensors.

More than 500 software variants - make approx 500,000 tests yearly.

Measuring light intensity and colour, if possible.

First collaborative robot. Assembles approx 200,000 FlexClamps yearly.



Controllers

Mechanical assembly, box build, test and programming

Yearly production of more than 25,000 controllers (production, climate, alarm and emergency controllers).

Approx 10,000 small controllers (DOL 31, DOL 20 etc.)

More than 60,000 winch motors yearly (DA 74, DA 175 etc.)



硬體設備與環境監控



硬體設備與環境監控



硬體設備與環境監控



硬體設備與環境監控



適當飼養密度，足夠採食空間



- 所有豬隻要能同時吃料
- 7 kg = 12cm
- 30 kg = 22cm

智慧化分流和餵飼系統提高整齊度



智慧化分流和餵飼系統提高整齊度

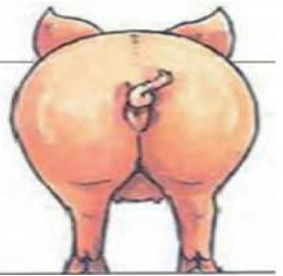
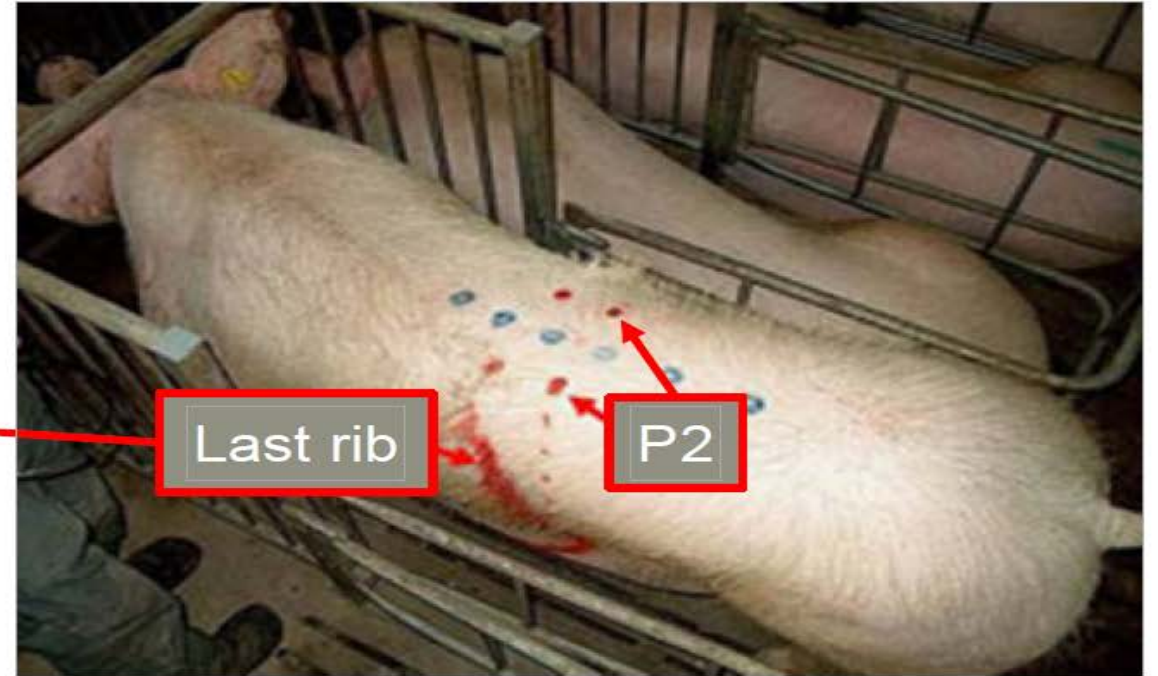
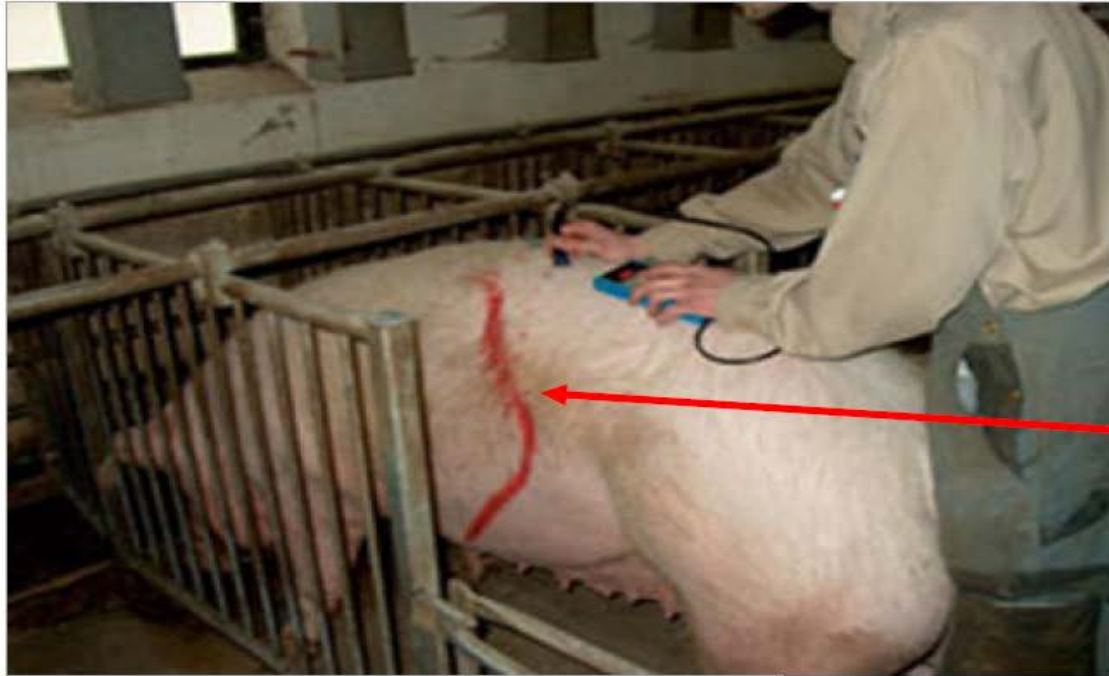


- 離乳3天後開始用公豬試情
- 配種舍至少200 lux 16 小時
- 待產夾欄至少100 lux 16 小時

丹麥女豬建議空間需求

女豬空間需求			
體重		法規	建議
- 10 kg		0,15 m ² per animal	
10 - 20 kg		0,20 m ² per animal	As legislation
20 - 30 kg		0,30 m ² per animal	
30 - 50 kg		0,40 m ² per animal	
50 - 85 kg		0,55 m ² per animal	0,75-1,00 m ² per animal
85 - 110 kg		0,65 m ² per animal	0,75-1,00 m ² per animal
110 -		1,00 m ² per animal	1,50-1,90 m ² per animal

測量背脂厚度調整BCS



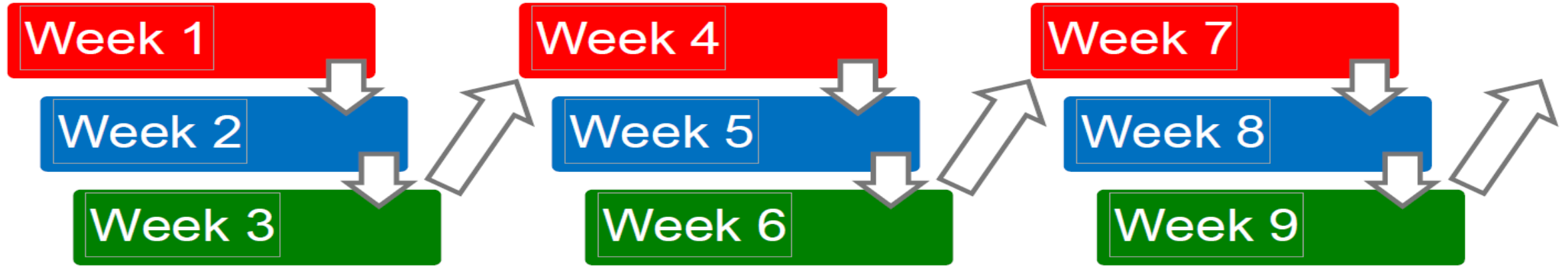
Backfat <12 mm

<16 mm

16-19 mm

>19 mm

智慧化分流和餵飼系統提高整齊度





丹麥母豬的生產性能

Litter Performance		2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
第一胎%		22,7	22,6	23,5	24,3	23,7	23,5	23,9	23,5	23,9	24,7	23,6
活仔數		16,9	16,3	15,9	15,6	15,4	15,1	14,8	14,5	14,2	14,1	14
死仔數		1,8	1,7	1,7	1,7	1,7	1,7	1,8	1,8	1,9	1,8	1,8
離乳頭數/胎		14,6	14,1	13,8	13,5	13,3	13,1	12,7	12,4	12,2	12,1	12,1
泌乳天數		31	31	30	31	31	31	31	30	31	31	32
離乳體重		6,5	6,6	6,8	6,9	7	7	7,1	7,2	7,4	7,4	7,3
離乳前死亡率		13,6	13,3	13,4	13,6	13,7	13,7	13,9	14,2	14	13,9	13,8
總死亡率 %		21,7	21,3	21,5	21,9	22,3	22,4	23	23,6	24,2	23,9	23,4
Reproduction performance												
非生產天數		12,4	12,7	13	13,6	14,2	14,1	13,8	14,2	14,9	15,3	14,8
離乳到第一次AI天數		5,6	5,7	5,7	5,8	5,9	5,9	6	5,9	5,6	5,6	5,1
重發情, %		4,8	5,2	5,3	5,9	6,5	6,1	6,1	6,4	6,6	6,9	6,4
分娩率, %		89,2	88,6	88,1	87,2	86,6	87	87,3	86,7	86,4	86	86,7
PWSY		33,3	32,2	31,4	30,6	30	29,6	28,8	28,1	27,5	27,2	27,3
每年胎數		2,28	2,27	2,27	2,26	2,25	2,26	2,26	2,26	2,25	2,24	2,25

丹麥母豬的生產性能

Litter Performance	Top 25%	Middle 50%	Buttom 25%
第一胎%	21,4	22,9	23,2
活仔數	17,7	16,9	16,3
死仔數	1,8	1,7	1,8
離乳頭數/胎	15,6	14,6	13,7
泌乳天數	30	31	32
離乳體重, kg	6,2	6,4	6,8
離乳死亡率 %	11,8	13,5	15,6
總死亡率 %	19,8	21,5	23,9
Reproduction performance			
非生產天數	9,7	12	15,9
離乳到第一次A 天數	5,3	5,7	5,9
重發情, %	3,4	4,5	6,7
重發情, %	91,8	89,5	86,1
PWSY	36	33,3	30,9
每年胎數	2,33	2,28	2,21

丹麥母豬的兩階段寄養

Nurse sow – 2 steps



Danish Farm Concept ©



Wean
i.e. 12
heads



Move
12
heads



Do this
next!

Do this
first!

-and then
fill up this
sow with
newborn
piglets!

i.e. 4 heads



i.e. 5 heads



i.e. 3 heads



丹麥飼料配方狀況

- 除黃豆外，其餘飼料原料均為本地生產
- 玉米用量較少，以大麥和小麥為主
- 使用其他農業副產物，sunflower meal, rapeseed, sugar beet
- 飼料添加劑使用簡單化(酵素，酸化劑)
- 無熱緊迫問題，採食量高(水料)，肉豬營養濃度低
- 飼料成本大幅降低 (> 50%)
- 單位為FU，而非kg

丹麥系統建議營養配方標準(小豬)

Piglet weight	6-9 kg	9-15 kg	15-30 kg
Mcal / MJ DE/kg feed (NRC)	3.42 / 14.30	3.39 / 14.20	3.35 / 14.00
Mcal / MJ ME / kg feed (NRC)	3.28 / 13.74	3.26 / 13.64	3.21 / 13.44
MJ NE / kg feed (NRC)	2.48 / 10.40	2.46 / 10.31	2.40 / 10.05
EW / kg feed, NL	1.14	1.13	1.09
FUgp / kg, DK	1.17	1.15	1.11
MJ DE / ME per FUgp	12.2 / 11.7	12.3 / 11.9	12.6 / 12.1
Total gram per kg, achieved in the examples (table 4)			
Crude protein	198	194	195
Phosphorus	6.2	6.0	5.6
Calcium	7.6	9.3	8.9
Lysine	14.4	13.4	13.1
Methionine	4.6	4.2	4.1
Met + cys	7.8	7.5	7.5
Threonine	9.0	8.5	8.3
Tryptophan	2.9	2.8	2.7
Isoleucine	8.3	7.9	7.8
Leucine	15.4	15.1	15.0
Histidine	4.7	4.7	4.8
Phenylalanine	9.4	9.3	9.2
Phenylalanine + tyrosine	16.4	16.2	16.0
Valine	9.9	9.4	9.2

丹麥系統建議營養配方標準(肉豬)

Pig weight	30-45 kg	45-65 30-105 ²	65-105 kg
Mcal / MJ DE/kg feed (NRC)	3.22 / 13.49	3.19 / 13.36	3.16 / 13.23
Mcal/ MJ ME / kg feed (NRC)	3.11 / 13.01	3.09 / 12.92	3.063 / 12.82
Mcal / MJ NE/ kg feed* (NRC)	2.35 / 9.83	2.34 / 9.79	2.34 / 9.79
EW /kg feed, NL	1.06	1.05	1.05
FUgp/kg, DK	1.08	1.07	1.07
MJ DE / ME per FUgp	12.5 / 12.0	12.5 / 12.1	12.4 / 12.0
Total, gram per kg, achieved in the examples (table 5)			
Crude protein	165	154	142
Phosphorus	5.0	4.8	4.5
Calcium	7.6	6.9	6.4
Lysine	10.4	9.4	8.6
Methionine	3.1	2.8	2.6
Met + cys	6.2	5.8	5.4
Threonine	6.9	6.5	6.0
Tryptophan	2.15	2.0	1.8
Isoleucine	6.1	5.6	5.1
Leucine	11.8	10.9	10.2
Histidine	4.0	3.7	3.4
Phenylalanine	7.4	6.8	6.3
Phenylalanine + tyrosine	12.6	10.5	10.5
Valine	7.5	7.0	6.5

丹麥系統建議營養配方標準(母豬)

Category	Lactating sows + Gilts 30-65 kg	After weaning ² + Gilts 65-105 kg	Gestating sows + Gilts >105 kg
Mcal/MJ DE/kg feed (NRC)	3.18 / 13.29	3.10 / 12.95	3.06 / 12.81
Mcal/ MJ ME / kg feed (NRC)	3.08 / 12.87	3.01 / 12.60	2.98 / 12.47
Mcal / MJ NE/ kg feed (NRC)	2.37 / 9.90	2.31 / 9.67	2.27 / 9.51
EW / kg feed, NL	1.08	1.05	1.05
FUsow / kg, DK	1.09	1.05	1.02
MJ DE / ME per FUsow	12.2 / 11.8	12.3 / 12.0	12.5 / 12.2
Total, gram per kg, achieved in the examples (table 6)			
Crude protein	145	124	117
Phosphorus	5.1	4.4	3.9
Calcium	8.1	6.9	6.7
Lysine	8.3	6.3	5.2 ²
Methionine	2.6	2.1	2.0
Met + cys	5.4	4.6	4.5
Threonine	5.7	4.4	4.1
Tryptophan	1.75	1.45	1.35
Isoleucine	5.4	4.4	4.1
Leucine	10.5	9.0	8.5
Histidine	3.5	3.0	2.9
Phenylalanine	6.6	5.5	5.1
Phenylalanine + tyrosine	11.2	9.3	8.7
Valine	6.7	5.8	5.5


水料與自動配料系統

- 水料系統增加採食量，減少揚塵
- 自動配料系統降低人力，提高精準度



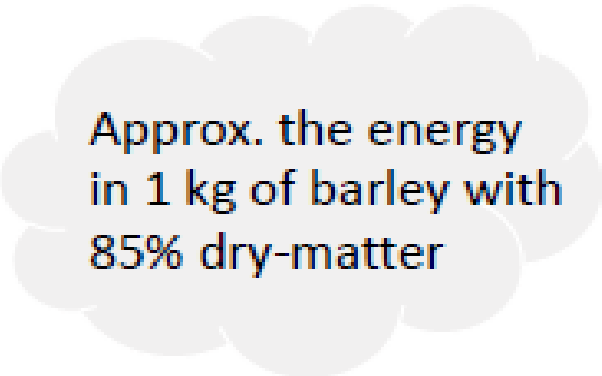
丹麥肉豬生長性能

7-30 kg	Average	Best 25%
Daily gain (grams)	460	502
FCR (FUgp)	1,83	1,71
Mortality	3,1	2,6
30-100 kg	Average	Best 25%
Daily gain (grams)	986	1045
FCR (FUgp)	2,60	2,49
Mortality	3,1	2,2

2019, numbers provided by 

1 Feed Unit for sows (FU_{sow}) = 7.700 kJ = 1.840 kcal

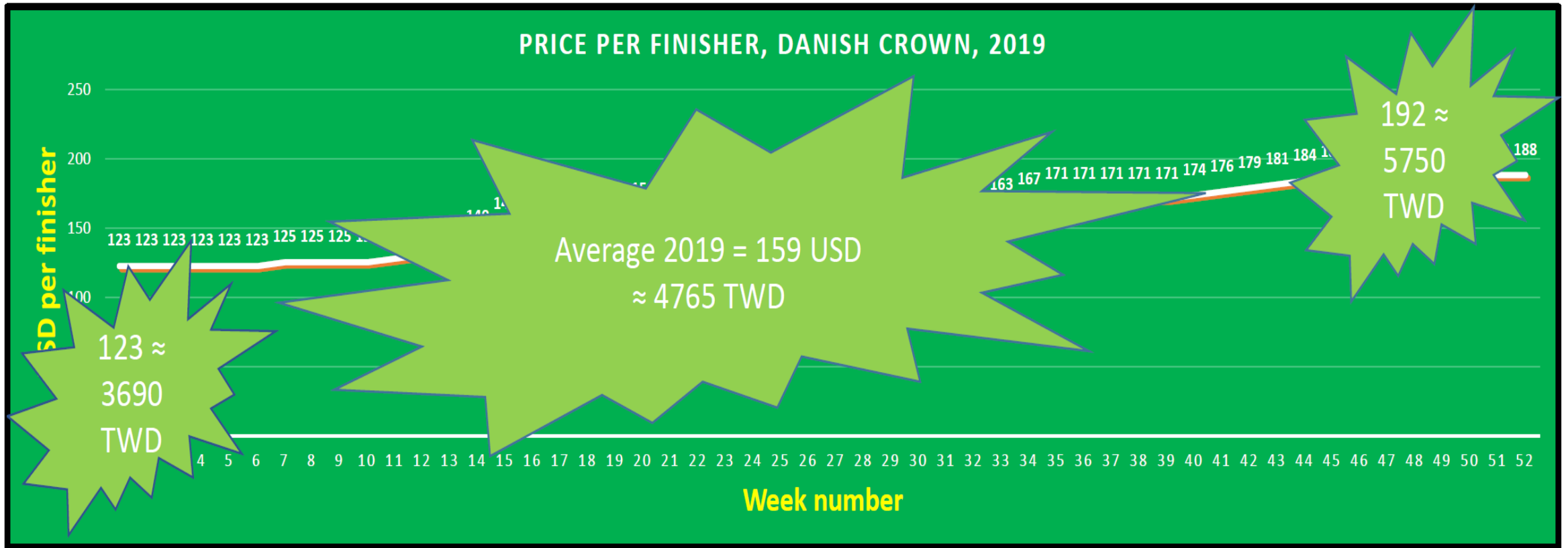
1 Feed Unit for growing pigs (FU_{gp}) = 7.375 kJ = 1.763 kcal



Approx. the energy
in 1 kg of barley with
85% dry-matter



丹麥2019年的豬價



(Renaudeau et al., 2019)

結論

- 丹麥豬場的管理特色是多面向條件進化而來，許多作法不適合台灣現場
- 台灣與丹麥市場需求和導向不同，也間接影響成績的落差
- 用最好的設備提供最適合的環境給豬隻，是要達到好成績所必需的
- 培育年輕一代的專才是養豬產業的最大資產



謝謝聆聽